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14655
PNEUMATIC THERAPEUTICS.

BY

ALFRED S. HOUGHTON, M.D.,

OF CHICAGO,

AND

P. C. JENSEN, M.D.,

OF CHICAGO;

WITH EDITORIAL COMMENTS.

*Reprinted from the Journal of the American Medical
Association, November 7, 1885.*



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THE TREATMENT OF PULMONARY DISEASE BY PNEUMATIC DIFFERENTIATION.

BY ALFRED S. HOUGHTON, M.D.,

OF CHICAGO.

A novelty in therapeutics, be it a drug or a device, is liable to suffer one of two fates, *i. e.*, disuse from merited distrust, or misuse from misplaced confidence and unwarranted enthusiasm. If the pneumatic cabinet, which is open to the reproach of novelty, justifies its existence by a promise of sound usefulness, it is to be hoped that the profession will save it from both of these fates. Its proper place and uses should be fully determined by competent and reliable men, and it should be prevented from falling into the hands of unscientific investigators. That it has a useful place among the weapons that comprise a physician's armament, it is the object of this paper to show, but just how extensive its field is, remains for time and thorough investigation to demonstrate.

Dr. Vincent Y. Bowditch, in the *Boston Medical and Surgical Journal* of July 16, and the *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*, of August 1, confirms the cases reported by Dr. H. F. Williams in the *Medical Record* of January 17. Dr. Williams' further report of these cases and others before the Climatological Society appears in the *New York Medical Journal*, of October 3.

The cabinet is an instrument by means of which the following results are sought:

1st. The strengthening and developing of weak and poorly expanded lungs.

2d. The arrest of pulmonary disease in its earlier stages.

3d. The prolongation of life with comparative comfort in those cases of pulmonary disease in its later stages where a cure is impossible.

It is well determined that high altitudes have a marked influence over pulmonary disease. It has always seemed to me that John Hughes Bennett was right in saying "that if the process employed by nature could be discovered, and then imitated by art, we might ultimately arrive at the true principle of cure." Acting upon the belief that it was the influence of atmospheric pressure that gave to "high altitudes" their beneficial effects, the cabinet was constructed.

The cabinet is an air-tight chamber, in which the patient sits or reclines, breathing from the outside through a flexible tube. We exhaust a small portion of the air about him, causing a deep, easy and pleasant inhalation, filling every part of the lungs with the air or spray, producing a stronger and more regular circulation, bringing the blood into complete relation with the oxygen of the air, and introducing the medication in every recess with ease; we have now simply aided the patient to take a deeper breath than he otherwise could. We can then either produce a compression of the air about the body, compelling an evacuation of the lungs, and repeat the former movement, or we can continue the rarefied condition and let the patient expel the air by his own efforts. In this latter way we produce the same effect upon the lungs that a dumb-bell does upon the muscles of the arm, for the effort is to *exhale* and not to inhale. We thus have such complete control over the movements of respiration, that we can increase or diminish the force, frequency and depth of each breath at our pleasure, and without the slightest effort or discomfort on the part of the patient.

In addition, the mucus which patients attempt to remove by coughing, and which they can often only detach in small portions and sometimes not at all, is by this method loosened and easily expectorated. The lungs can also be medicated and disinfected in a better manner than by any other method. The

Simple Inhaler is the best spray-producing apparatus I have ever seen.

The following are the solutions that I have found useful, the last four being prepared expressly for Semple's Atomizing Inhaler by Parke, Davis & Co. The vehicle consists of fluid cosmoline, and in combination with various oils and balsams, the spray being more like a smoke.

SOLUTION NO. 1.

℞ Sol. Lugol.....℥ss.
Glycerine.....℥iii.
Aquæ ad.....℥x.
M.

No. 2.

℞ Hydrarg. Chl. cor.....gr. iv.
Ammon. Chl.....gr. x.
Glycerine.....℥ii.
Aquæ ad.....℥viii.
M.

No. 3.

℞ Ammon. Chl.....℥ii.
Glycerine.....℥iss.
Aquæ ad.....℥iv.
M.

No. 4.

℞ Calc. Hyphosphos.....℥i.
Glycerine.....℥i.
Aquæ ad.....℥iii.
M.

No. 5.

℞ Sol. Lugol.....20%.
Sol. Acid Carbol.....1%.
Ext. Hamamelis.....aa ℥i.
M.

No. 6.

℞ Ol. Picis liq.....℥ss.
Fl. Cosmoline.....℥i.
M.

No. 7.

℞ Ol. Eucalypti.....℥i.
Fluid Cosmoline.....℥i.
M.

No. 14.

℞ Acid Carbol.....gr. x.
Fluid Cosmoline.....℥i.
M.

No. 15.

℞ Fluid Benz. Comp.....℥i.
Tinct. Cosmoline.....℥ii.
M.

These last should always be diluted with cosmoline. So far as the medication is concerned, we have in the cabinet a means by which agents can be more easily, thoroughly, and deeply introduced than by other means, as is evident from the following facts:

Volumetric tests have shown us that by the use of the cabinet the amount of air inspired during each inspiration is increased from 50 to 100 per cent. over the amount inspired during normal tranquil respiration. This air is saturated with the medicament, as already explained. Repeated and exact hygrometric

and manometric tests have shown that if air is thus (unconsciously to the patient) introduced at a pressure of five-tenths of an inch, the effort to expel the same, or the expiratory movement, as well as the friction and inertia of the air passages, is equal to five inches, or an increase of 950 per cent., or a corresponding diminution of moisture in the air inhaled; against this, however, we have to consider the increase in moisture-carrying capacity due to higher temperature in the lungs; taking this into consideration, we have between the inspiratory and expiratory movements a reduction in vapor-carrying capacity and a consequent condensation of vapor at the farthest point reached by the inspired air, and as our volumetric measurement has shown that the entire air capacity of the lungs is occupied, the entire ærating surface must be bathed with the condensate; numerous experiments have shown this to amount to about twelve per cent. of the medicament used. Thus it will be seen that the effect of differentiation alone is not by any means the only beneficial action of the cabinet.

In contemplating the differential process more especially with reference to the respiratory movements and their effect upon the pulmonary capillary circulation, I have been so impressed with the intimate connection between them that I have come to conclusions that, while they are apparently at variance with much that has the sanction of investigation, nevertheless seem to me to harmonize with and rationalize much that is not very clear. Instead of regarding the initial steps in the tuberculous process as due to external and specific causes, I have come to regard primary pulmonary infiltration, whether it be perivesicular or intervesicular, as the result of a simple mechanical law, *i. e.*, *that force operating behind and resistance offering in front results in an unvarying manner, dependent upon the amount of force and the extent of resistance.* The force in this case

is the right ventricle; the resistance resides in the pulmonary capillaries.

But here comes into consideration another force which we shall find is to exert no small influence, viz.: the movements of respiration, for they may act to either increase the force operating behind or the resistance offering in front, the result being very different in one case from what it is in the other. Atmospheric pressure acting upon the pulmonary capillary circulation can effect either its retardation by antagonizing the action of the heart, or its acceleration by overcoming the resistance of the capillaries. The right ventricle alone is physically unable to propel the blood through the pulmonary capillaries with sufficient force to bring back a sufficient quantity to the left auricle to maintain the circulation (Draper). When the pneumogastric nerve is cut and the movements of respiration retarded and eventually stopped, we find the lungs solidified in a peculiar manner, for they are smaller and empty of air (Dalton).

What, then, is the force that carries on and perfects the capillary circulation through the lungs? If we produce artificial respiration in an animal in which the movements of respiration have been abolished, and in which the capillary engorgement has occurred, together with arrest of the heart, we will not only overcome the engorgement but reëstablish the cardiac pulsations (Dr. Cartwright, *Boston Medical Journal*, Jan. 7th, 1852). It is therefore *proved* that the movements of respiration are the mechanical aid in complete pulmonary capillary circulation. Now comes into consideration whether inspiration or expiration is the essential force in propelling the blood to the left auricle.

[NOTE.—It is held that during inspiration the effect of the diminished atmospheric pressure within the thoracic cavity not only causes the expansion of the lungs and inspiration of air, but also the *aspira-*

tion of blood into the thoracic blood-vessels; that this does occur to a certain extent is certainly proved, but not to the extent of affecting the pulmonary capillary circulation, is evident when we consider to what advantage the atmospheric pressure acts through the open trachea and bronchi upon the air vesicles, as contrasted with the closed and resisting tissues about the systemic circulation. Foster, in his work on Physiology, devotes several pages to this subject, but one important fact is overlooked; and that is, that no amount of rarefaction about a vessel will cause its expansion unless its cavity communicates with the atmosphere; for it is the pressure of the atmosphere that compels the expansion. To talk about the aorta being increased in calibre by the effort of inspiration, seems absurd; and, when we come to consult the diagram he gives of the effect on blood pressure and its relation to the intrathoracic pressure produced by the respiratory movements, we find that the opposite from what we had been led to expect, was true. He says: "When, however, the respiratory undulations of the blood pressure curve are compared carefully with variations of intrathoracic pressure, it is seen that neither the rise nor the fall of the former are exactly synchronous with either diminution or increase of the latter." The fact is, that the rise in arterial tension follows closely the inspiratory act, and that the fall corresponds with the expiration. What does this teach? That inspiration is a *force*; that it is the "*prime* force in originating the circulation." (Draper.) My experiments with atmospheric pressure during the last two years compel me to this conclusion.

How can atmospheric pressure affect cerebral circulation, protected as it is by the unyielding calvarium? Is it not a much more rational explanation to give to the increased arterial tension due to inspiration, the position of cause in the cerebral wave mentioned by Foster?]

Having decided that inspiration is *the* movement that furthers the capillary circulation through the lungs, we now come to consider the effect of expiration. If we study the microscopical appearances of a pulmonary lobule, we find that the capillaries dip down between the alveoli, and are so arranged that the expansion of the air vesicles *must compress* them, and that the contraction of the air vesicles must not only allow them to be fully filled with blood from the right heart, but compel a temporary stasis of the blood in them, owing to the increased resistance which the absence of inspiration permits. It is shown, then, that inspiration acts to further the pulmonary circulation by removing the stasis that has occurred during expiration, and overcoming the capillary resistance in front; but the moment the movement of inspiration ceases, the stasis re-occurs, for the force that has been acting ceases, the diaphragm begins to rise, the ribs to fall, and the atmospheric pressure is overcome.

What happens then, when the inspiratory movement is not vigorous? By vigorous, I mean normal vigor, sufficient to expand every air-cell, but not forcibly. When any portion, no matter how small, is not fully expanded? There must be stasis, and attendant upon stasis transudation, dependent upon the extent of non-expansion and its area. Now, where will such transudation occur? We have shown that when the movement of inspiration is not exerted in any portion of the lungs, no matter how small, it increases the resistance, and consequently the point of deposit must be on the cardiac side of the resisting point, into the weakest structure, therefore *perivesicular*.

But we have another condition when the movement of inspiration *is* not only vigorous, but forcible; when the heart's action is also vigorous, when force is augmented by force, but now the point of resistance has passed to the thin wall of the fully expanded air-cell,

and the rupture and deposit takes place there, and we have *intervesicular deposit*. In other words, we have in the first case, a passive condition of the lungs acted upon by a force that alone is unequal to the task of overcoming the resistance, and the stasis that follows results in perivesicular deposit. In the second case, we have an active condition of the lungs acted upon by an accelerated heart, increased primarily by the inspiratory movement, but resisted secondarily by the same movement having been converted from force into resistance, resulting in intervesicular deposit.

[NOTE.—To make this latter point clear, let me remind the reader that in forced inspiration we have, as is seen in emphysema, an exsanguinated condition of the alveolar capillaries; imagine, therefore, a vigorous inspiratory movement not sufficient to cause emphysema, but such as one takes when subjected to sudden cold, at a time when the heart's action is rapid and forcible; as the air-cell expands it augments this force, especially, as towards other lobules, in which the expansion being forced, it reaches the point when it becomes resistance. I do not mean that under such circumstances transudation always occurs, but when for any reason it does occur, it must be into the air-cell itself.

Let x represent the heart's force; y the inspiratory vigor; and z the capillary circulation. Then we may represent these conditions by the following equations.

$$\begin{array}{rcccl}
 x & + & y & = & z \\
 x & & y & < & z \\
 x^2 & + & y^2 & > & z \\
 x & < & y & + & z
 \end{array}$$

With perfect equilibrium between force and resistance, no deposit can occur. Deposit once having occurred, the subsequent changes depend on varying influences. The bearing of this upon pneumatic differentiation is clear, because, if correct, the rational

treatment (theoretically) is to restore the equilibrium between force and resistance, and it naturally follows that the nearer we approach to the condition of primary deposit the more readily can aid be afforded. Let us see then if *theory* is borne out by experience.

It may be here objected that the pressure used in the cabinet must be greater than vigorous inspiration, and therefore further the production of intervesicular deposit. I do not doubt that this is possible, if the pressure be carried up to two or three inches, but this is never done, and further coughing exerts more strain on the air-cells than is possible in the cabinet; further, it is shown that the heart is not accelerated.

Dr. Williams reported in the *Medical Record*, of January 17th, sixteen cases of primary deposit and acute phthisis, ten of whom recovered. It was my good fortune to be familiar with the majority of these cases, and to examine them, and it is hardly necessary to state that the nearer their condition approached the primary deposit the more complete was the removal of the adventitious sounds.

In reporting the following cases, I shall classify those of phthisis more in accordance with their acuteness or chronicity (that is nearness to primary deposit) than with reference to their anatomical or pathological characteristics; accordingly I shall speak of acute phthisis as consisting of three stages: the first extending from the initial infiltration to the beginning of the febrile movement; the second extending from the advent of the febrile excitation through the period of deposit extension to the period of septic disintegration, which constitutes the third stage of excavation. I shall include under the term chronic phthisis, those cases of chronic pleurisy and chronic pneumonia that have fibroid pulmonary deposit and also syphilitic phthisis. I consider the *first stage* of phthisis as present when the slightest evidence of diminished pulmonary expansion and respiratory vigor is present, and it is here that the influence of pneumatic differ-

entiation, together with action of well selected agents, cuts short the impending process. I regard the second stage as beginning when the temperature runs above 100° or 101°, it is here that antiseptics and germicidal agents must be pushed to the limit of prudence if we hope to prevent the development of the third and *last* stage, when septic degeneration and excavation have taken place. Dr. Williams reports five recoveries in patients who had reached this stage. Such results seem almost incredible, and are shown by further reference in his last publication to be exceptional, yet these undoubted results inspires the hope that by judicious selection of "antiseptic," "tonic," or perhaps "nutritive" agents we can at least prolong the lives of such patients in comparative comfort.

The following table embraces all the patients that I have independently treated with the Pneumatic Cabinet, ten of whom were treated with a primitive apparatus in Milwaukee. These ten embrace three of primary deposit, two of second stage, one of third stage, and one of chronic phthisis, two of whom died :

	No. of Cases.	Recover- ies.	Improve- ments.	No Improve- ment.	Result Un- known.	Deaths.
Chronic Bronchitis.....	5	1	1	1	2	
Asthmatic Bronchitis.....	2		1	1		
Asthma.....	1	1				
Acute Phthisis, first stage.....	9	4	4	1		
" " second stage.....	4		3	1	1	
" " third stage.....	5		1	1		2
Chronic Phthisis.....	7		2		3	2
Unresolved Pn�monia.....	1		1			
Total.....	34	6	13	5	6	4

Number in whom result is not known, six, of whom six took less than three treatments each.

Of the four cases of acute phthisis, first stage, that were improved, two are still under treatment, one is in California for the winter, and the other took treat-

ment in Milwaukee up to the time the apparatus was useful; the one case that did not improve only took nine treatments. Of the three cases of phthisis in the second stage that improved, two are still under treatment; one went to California a year ago and I have not heard from him since. The case of third stage phthisis that is marked as improved, was already almost fully recovered when she came to me through Dr. Casselberry, of this city; she took seven treatments, and the doctor thought her slight cough was better, and noted an increase in expansion of half an inch. The two cases of chronic phthisis that were improved were both fibroid in character; one has gained ten pounds in weight and half an inch in expansion; the other about half an inch in expansion. The deaths in chronic phthisis occurred in advanced cases, one of fibroid phthisis, with bronchiectasis, the other of syphilitic phthisis.

One death in the third stage occurred in a case in which the symptoms of septicæmia were the most violent I have ever seen; the other was in a case in which decided and continued improvement was present so long as the apparatus was air-tight. The following is the history:

Mrs. E. O., aged 40, married; present weight 130 pounds. First seen August 21, 1884, with Dr. O. W. Carlson, Milwaukee. History of pneumonia two years previously, followed by great emaciation, night sweats, cough, with profuse expectoration and hæmoptysis. Physical examination revealed dulness, increased vocal fremitus and resonance, with bronchophony lower lobe of left lung. Temperature, A.M., 100; P.M., 101.2; pulse 100, respiration 29. First treatment was solution No. 2, under pressure of two-tenths of an inch for ten minutes. This treatment was continued thrice weekly, the pressure being gradually increased to seven-tenths of an inch.

November 6th her weight was 139 pounds. Temperature had been normal for two months, and respi-

ration 16. The cabinet gave out Oct. 29th, and on the 13th of November her temperature was 101.2; after that she gradually grew worse and died last spring.

Of the four cases of recover in first stage phthisis all but one had more or less deposit; she complained of soreness of the chest, with cough, and as her brother had died of phthisis, her friends brought her to me for the purpose of strengthening her lungs. She is now perfectly well, the moral effect of the treatment has removed the morbid fear she had of consumption. The other cases I will give as full an account of as space will permit.

Case 1.—Henry B., aged 15, came to me through Dr. P. C. Jenson, who will give a full account of the case. (See following article, this number, p. 510.)

May 29th Henry weighed 72 pounds, and was quite anæmic. Physical examination showed marked infra-clavicular depression, increased vocal fremitus and resonance, dulness and diminished respiratory murmur, and cog-wheeled respiration on the right side at apex and infra-clavicular region. Temperature, A.M., 97.8, P.M., 100.

June 3d. marked improvement; weight 73½ lbs. Temperature, A.M., 98, P.M., 100.

June 10th. continued improvement; weight 75½ lbs. Temperature, A.M., 98.5, P.M., 99.

June 23d. temperature has been normal for a week.

July 8th. temperature has been normal since; now weighs 86 lbs.

September.—Physical examination shows only slight roughness on expiration.

Case 2.—Sarah W., aged 25, unmarried. First seen during miscarriage. Under these circumstances her real name was never learned. At this time she had a cough, and I advised her to try the treatment as soon as she was able.

May 30th.—She came to my office for her cough, she said. Upon examination evidence of collapse

and slight perivesicular deposit were discovered at both apices. Temperature 99.5; pulse 100.

June 6th.—Considerable improvement. Temperature 99; pulse 100.

June 13th.—Great improvement. Temperature 98.4; pulse 80.

On examination I found a free respiratory murmur at both apices, no roughness nor jerking.

July 16th.—Is now entirely recovered. The treatment in this case was solution No. 1.

Case 3.—Miss J. S.; aged 25, single. Present weight, 125 pounds. First seen with Dr. Robert H. Babcock, who furnishes the following history: "Patient was prostrated last May with what she supposed to be a severe bronchitis. The writer (Dr. Babcock) was called to see her, and after repeated careful examinations of the chest and an observation lasting several weeks, came to the definite conclusion that the case was one of incipient tuberculosis of the apex of the left lung. Under appropriate treatment she improved, and in June was able to be about. Desirous of trying the effect of pneumatic differentiation in her case, the writer persuaded her to take a course of treatment from Dr. Houghton."

Record as kept by Dr. Houghton:

June 4th, 1885.—First treatment, *no spray* at any time, .3 pressure, 16 respiration.

June 20th.—Fifth treatment, 3 inches expansion, .9 pressure, 11 respiration.

June 29th.—Ninth treatment, .8 pressure, 5 respiration.

July 3d.—Twelfth treatment, $4\frac{1}{2}$ inches expansion, .8 pressure, weight 130 pounds.

July 27th.—Sixteenth and last treatment, 5 inches expansion, .8 pressure, weight 130 pounds.

Sept. 17th.—She was looking very well, and voice much stronger. Weight 136 pounds. Went with opera troupe as chorus singer.

"These treatments were continued at intervals of

several weeks. The one result, established beyond doubt, was a better expansion of the chest. The anterior border of the left lung, which had been previously somewhat retracted and evinced, during percussion, but slight, if any, expansion upon forced inspiration, revealed in August last less retraction, and showed ampler excursion movement during inspiration. The writer was never able to satisfy himself that the pitch of the percussion note over the affected apex became any lower, or that the respiration revealed any other change than a disappearance of the jerkiness which had first characterized it in a circumscribed area. Whether the disappearance of her cough and expectoration was due to the treatments in the cabinet or to the improvement in her health from other causes, is a question. Subsequently, in September, her cough and expectoration returned." [Signed] ROBERT H. BABCOCK, M.D.

Taking all things into consideration, I am impelled to the following conclusions, *i. e.*, that

1. Pneumatic differentiation is of undoubted service in all conditions of primary infiltration.

2. Where the febrile movement has been unchecked for many weeks before treatment, improvement, if any, will show itself within the first ten or twelve applications; if there is no abatement of symptoms its continuance is of questionable utility, and it may be absolutely contra-indicated.

3. That phthisical disease at the apices is more favorably treated than when at the base of the lungs.

4. That it is possible by this means to more thoroughly medicate the lungs than by any other known method.

5. That the expansion of the lungs by differentiation is itself a therapeutic measure of great merit.

6. That peri- and inter-vesicular exudation is capable of cure by this method, and even third stage phthisis is benefited, at least temporarily.

My experience is that when the febrile movement

is excessive, when the evidences of septicæmia are pronounced, it is not wise to use the pneumatic cabinet certainly until these symptoms have subsided. In cases of chronic bronchitis I have had so little experience that I can only say that if the proper remedy can be found its application is easy enough. Articles and authorities consulted on the subject of pulmonary capillary circulation as affected by the respiratory movements were

John C. Dalton, Human Physiology.

John W. Draper, Human Physiology.

A. L. Loomis, Practical Medicine.

Wm. Pepper, Third Volume System of Medicine.

Thomas H. Huxley, Physiology.

Dr. Cartwright, in the *Boston Medical and Surgical Journal*, 1852.

Miss E. Willard, Motive Power in the Circulation.

Dr. Alonzo Clark, Diseases of the Heart.

James R. Leaming, in Birmingham's Library.

M. Foster, M.D., Physiology.

Landois & Sterling, Physiology.

Central Music Hall, Chicago, October 20th, 1885.

ACUTE CATARRHAL PHTHITIS; RECOVERY.

BY P. C. JENSEN, M.D.,

OF CHICAGO.

On April 25, 1885, I was called to see H. B., æt. 14, who had been sick three weeks with catarrhal pneumonia. for which he had been treated by another physician, and a favorable prognosis had been given. The persistency and continued aggravation of the symptoms changed his diagnosis to phthisis, and he now gave an unfavorable prognosis.

When I took charge of H. B., I found him greatly emaciated, with large and well-marked subclavicular depressions, and but little respiratory mobility. He was continually getting more debilitated from loss of appetite and exhausting night sweats. There was an almost continuous cough, a profuse purulent expectoration, offensive in character, containing much solid substance which would sink in water. In color it ranged from grayish white to greenish brown. The temperature reached 102° in the afternoon, but was subnormal in the morning. The respiration was short, hurried and superficial, about twenty-eight to thirty-two per minute. Pulse 120 to 140 per minute, volume small, and beat irregular.

Physical Examination.—On auscultation, bronchial râles were distinctly heard, due to exudate in the bronchial tubes. There was audible a hollow or cavernous sound, as if a small cavity existed in the right lung. There was decided bronchial respiration of right lung, and an almost complete absence of the normal vesicular respiratory murmur on the same side; while over the left side the lung sound was exaggerated (puerile respiration). The impulse of the heart apex could be distinctly felt on the right side, and was still more distinctly audible by the stethoscope, thus indicating a partial consolidation of lung structure on that side.

The medical treatment consisted of the following combination :

- R Tr. Nucis Vomicae..... gtt. x.
 Tr. Digitalis..... gtt. vj.
 Maltine ℥iij.
 Syrupi Hypophosph. Comp..... ℥j.
 M.
 S. Take one-half hour before mealtime three times daily.
- R Quiniae Sulphatis..... gr. ij.
 Pulv. Iodoformi..... gr. ij.
 Ferri Sub-Carbonatis..... gr. ij.
 Ext. Belladonna Alc..... gr. 1-5.
 Podophyllin..... gr. 1-20.
 M. et ft. Capsule No. 1.
 Sig. One capsule after each meal.

As the patient was in a wasting condition, and as malassimilation and denutrition only increased the exhaustion and debility, remedies whose action promotes nutrition and tonicity were indicated. To aid in this direction, one ounce of cod-liver oil was given by inunction three times a day. The parts selected for the application of the oil were the axillary spaces, groins, bends at elbow-joints and popliteal spaces. Preceding the inunction, the parts were rendered hyperæmic by friction with mustard, which facilitates absorption. To aid in checking the night sweats, and also for its soothing anodyne effect in relieving the irritability of the lungs produced by movement, a large belladonna plaster was applied over the chest. Belladonna plasters act indirectly, but very efficiently, in giving relief to cough and local pain by quieting the irritability upon which the cough depends. Improvement began immediately ; the night sweats gradually subsided, the appetite increased, and in three days from the commencement of the iodoform treatment the sputa had lost its odor, and the quantity expectorated much diminished. The cough was relieved for a while by the remedies given, but was afterwards checked by the following mixture :

R	Morphiæ Sulphatis.....	gr. j.
	Ant. et Pot. Tartratis.....	gr. ij.
	Ammonii Carbonatis.....	ʒss.
	Acidi Hydrocyanici Dil.....	gtt. xxv.
	Spts. Chloroformi.....	ʒiss.
	Syr. Bals. Tolutani q s. fl.....	ʒiv.
	M.	

S. Take one-half teaspoonful every three hours.

In about three weeks from commencement of my treatment, H. B. was sitting up convalescent, but seemed apparently at a stand-still. The respiratory murmur still partook of the bronchial character, and the temperature would not go below 99.5°, except in the morning, when it was always subnormal. Thinking that if we could clean out his lungs and free them from the accumulation of pathological exudates, he would soon recover, my attention was directed to the Pneumatic Cabinet. Dr. Houghton thought the case one which would be benefited by the Cabinet. He examined the patient in my presence, but could not then, nor could I detect any cavity at this time. But Dr. Houghton agreed with me in the diagnosis: first stage of acute phthisis, with intervesicular deposit.

The spray, which was used by inhalation in the Cabinet, consisted of one part corrosive sublimate and a small quantity of ammonium muriate to 500 parts of water. The improvement in the patient from that time on was astonishing. The patient states that the metallic taste peculiar to mercuric chloride spray was perceptible all day, and that the taste was distinctly imparted to the sputa. This seems to me fair evidence that the spray must have penetrated the minute ramifications of the bronchioles and air vesicles. This brings me up to Dr. Houghton's notes (see previous article, p. 509).

The anæsthetic effect of iodoform, and the peculiar symptoms of perverted sensation, muscular incoördination, diplopia, etc., are due to its action in part upon the nervous system. In regard to the internal use of iodoform, I would say that I have

used it considerably, both in syphilitic, scrofulous and phthisical cases, but in the last two only when purulent or putrefactive changes are going on. In cases where there is much expectoration of an offensive character in various stages of decomposition, good results have been obtained by internal administration of iodoform. I believe it has a restraining influence over such pathological changes as ulceration, suppuration, necræmia, necrosis, tubercylosis, and retrograde metamorphosis in general. Iodoform, whenever administered internally, should be given with caution, as it is a powerful depressant to the circulatory and respiratory systems. In cases in which it has been given in large single doses, and occasionally in persons where small doses have been given for a considerable length of time, bad results have been observed. In the "National Dispensatory," 2d edition, page 782, we read as follows: "Several cases of poisoning by this preparation have been recorded. A woman affected with syphilis had taken in the course of four months about 42 grmm's (3i 3iij) of iodoform in pills containing each one centigramme ($\frac{1}{8}$ gr). She was suddenly attacked with faintness, vertigo, and double vision: within two days she sank into a deep sleep which lasted for thirty-six hours, and was followed by excitement, violent headache, and confused speech. These symptoms were succeeded by debility and a tottering gait, after which the vertigo, headache and diplopia recurred. This series of symptoms lasted for a fortnight. In the case of another woman, the toxical phenomena occurred at the end of the first week, and when no more than 5 grammes (75 grs.) of iodoform had been taken. She slept continuously for five days, after which debility and vertigo were experienced for several weeks. (Oberlander)."

In my own experience, I have observed no such phenomena from the use of iodoform internally. But in every case in which I have employed it as an in-

ternal remedy, the combination with nux vomica, digitalis, and ext. belladonna overcomes or prevents its depressing influence upon the circulation and respiration; and as these remedies are cardiac and respiratory tonics, I think it a most rational method of obviating the dangerous effects sometimes resulting from the internal use of iodoform.

Chicago Opera House Building.

THE
Journal of the American Medical Association.
PUBLISHED WEEKLY.

THE EDITOR OF THIS JOURNAL would be glad to receive any items of general interest in regard to local events, or matters that it is desirable to call to the attention of the profession. Letters written for publication or containing items of information should be accompanied by the writer's full name and address, although not necessarily to be published. All communications in regard to editorial work should be addressed to the Editor.

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Address

JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION,
NO. 65 RANDOLPH STREET,
CHICAGO, ILLINOIS.

SATURDAY, NOVEMBER 7, 1885.

PNEUMATIC DIFFERENTIATION.

The article by Dr. HOUGHTON, which appears in this issue of the JOURNAL, is the fourth and last contribution upon the merits of the Cabinet known by the rather cumbrous name of "Pneumatic Differentiator." Dr. Herbert F. Williams, of Brooklyn, brought it to the notice of the profession at large by a report in the *New York Medical Record*, Jan. 17, 1885, of its trial in sixty-four cases of various pulmonary complaints. He subsequently discussed its action and limitations before the Climatological Society at its meetings in New York last Spring. A report of his paper, together with remarks upon it by

Drs. Armour and Loomis, may be seen in the *New York Medical Journal* of Oct. 3, 1885. In the columns of the *JOURNAL* of Aug. 1, 1885, is an article by Dr. Vincent Bowditch, of Boston, wherein he reviews the subject of pneumatic therapeutics and cabinets and the Differentiator greatly to the advantage of the latter. Dr. Houghton's paper and an editorial comment in the *JOURNAL* of Feb. 14, current year, complete, we believe, the literature upon this subject up to the present time.

The Cabinet possesses decided merits as will be seen by the perusal of Dr. Williams' reports. In our comments last February we took the view that it is practically the same in its effects as the administration of compressed air, and from further reflection, as well as personal investigation of the Cabinet, we see no reason to change our opinion. However, there is one respect in which the "Differentiator" is certainly superior to all portable air-condensing machines: This is the facility and thoroughness with which medicaments can be carried into the lungs. Were this the sole merit of the Cabinet, it would be of value, but since it promotes a better expansion of the chest in individuals of the superficial respiration, it thus constitutes a powerful means for the prophylaxis of tuberculosis. Yet this is not all; as shown by the report of cases by Drs. Williams and Houghton, the use of the Cabinet confers permanent benefit in non-tubercular catarrhal conditions of the bronchial mucous membranes, as well as in atelectasis and compression of the lungs. In pulmonary tuberculosis improvement generally results, while in a few

cases, as reported by Dr. Williams, there seems reason to believe that the process has been arrested. It is thus seen that the Differentiator accomplishes all that has ever been claimed for compressed air. Indeed it is not unreasonable to predict that, owing to its superiority in the thoroughness with which atomized solutions may be carried into the lungs, even more brilliant achievements may characterize its employment. As in the inhalation of compressed air, not the least important of its benefits is its ability to check hæmoptysis, and herein, as well as in all other respects, the similarity of its action to that of compressed air is presumptive evidence that Pneumatic Differentiation is but a method of administering air under increased pressure, and a few moments' reflection will suffice to convince any one that such is the case. We may therefore with propriety apply to Pneumatic Differentiation Waldenburg's explanation of the effects of his apparatus.

He describes the effect of respiration upon the heart and arterial system as follows: In consequence of negative pressure within the lungs, the primary effect of inspiration is an aspirating one upon the veins of the body. Their contents are emptied into the right side of the heart, and this organ contracting with diminished vigor, throws but a small amount of blood into the aorta, and blood-pressure within that vessel sinks. As soon, however, as atmospheric pressure in and out of the lungs becomes equal, all suction force upon the veins ceases, until at the close of inspiration and during expiration, positive pressure is exerted upon the heart and aorta. The ventricles

contract energetically, but receiving less blood they force less into the great vessels. Hence, during expiratory effort arterial tension is increased. When compressed air is inspired, its inrush is so sudden that an aspirating effect upon the veins is not exerted; the lungs quickly become distended, the veins of the neck grow turgid, and owing to the pressure exerted upon the heart and great vessels, arterial tension is increased, the same as in expiration. As this pressure persists during the ensuing expiratory effort, the effect of compressed air is the same as, and prolongs that of expiration.

In consequence of the alveolar distension, caused by the inspiration of condensed air, the pulmonary capillaries are subjected to a degree of pressure which partially exsanguinates them. This anemia of the lungs, which, according to Jaccoud, is likewise produced through the rarefied atmosphere of high elevations, directly favors the arrest of pulmonary hæmorrhage and engorgement; precisely the effect claimed by Drs. Williams and Houghton for their system of pneumatic therapeutics. But the beneficial influence of such a treatment is not merely local; there are constitutional effects which can be understood only by a knowledge of certain changes that take place in the arterial system. What Sommerbrodt says with reference to this, seems to us particularly satisfactory. An increase of the intra-bronchial pressure, according to that observer, whether from coughing, loud talking, laughing, and the like, the Valsalvan method, or the inhalation of compressed air, stimulates the sensory nerves of the lungs; hence

ensue, by a secondary reflex action, stimulation of the vaso-dilator nerves, lowering of arterial *tonus*, increase of the pulse rate and fall of blood pressure. At the same time also results a reflex lessening of the inhibitory influence of the vagus; the circulation is quickened and the secretion of urine is augmented. The teleological significance of all this is, that an increase of oxygen and nutrient material is supplied to the muscles concerned, and probably to the brain and nerve centres. In this reflex effect upon the systemic circulation to which much of the constitutional benefit of aërotherapeutics must be ascribed, lurks a danger which must not be overlooked. If the arterial coats be atheromatous, the dilatation of the vessels, which is meant to counteract the increased blood pressure, cannot take place sufficiently. Not only might rupture of an artery occur, but the strain thus imposed upon a weak heart might occasion its sudden failure. Owing to this and other dangers liable to follow its employment in the hands of ignorant or careless men, the Cabinet under discussion should be kept out of reach of charlatans, and we are glad to learn that measures to this end are adopted by the company controlling its manufacture. Only regular and reputable physicians are to be entrusted with the use of the Cabinet, at a yearly rental of \$250, as the machines will not be sold. We should be pleased to see Pneumatic Differentiation become widely adopted for the treatment of pulmonary diseases, but fear the rental required for the apparatus will militate against its acquisition in more than exceptional instances. We understand that five Cabi-

nets are already in use in Brooklyn, three in New York, one in Boston, one in Albany and one in Cincinnati. The recent improvements in its construction have made it easy of manipulation and efficient. We commend Dr. Houghton's Cabinet to the unprejudiced inspection of our readers who reside within easy access.

